Transport in Porous Media 2006 vol.63 N1, pages 99-125

Assessment of stimulated area growth during high-pressure hydraulic stimulation of fractured subsurface reservoir

Fomin S., Chugunov V., Hashida T.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

Hydraulic stimulation is performed by high-pressure fluid injection, which permanently increases the permeability of a volume of rock, typically transforming it from the microdarcy into the millidarcy range. After a period of stimulation, fluid injection and recovery boreholes are introduced into the stimulated rock volume, and heat is extracted by water circulation. In the present study a simplified mathematical model of non steady-state hydraulic stimulation is proposed and analyzed. Fluid flow is assumed to be radial, injected flow rate constant; and fluid density, rock porosity, and permeability depend on fluid pressure. The conventional boundary of the growing stimulated rock volume is introduced as a surface where the porosity and permeability of the stimulated rock exhibit a sharp decline and remain constant within the undisturbed area. The problem is solved analytically by a modified method of integral correlations. As a result, approximate close-form solutions for pressure distributions in the stimulated and nonstimulated (undisturbed) areas are obtained, and an equation for the moving boundary of the stimulated volume is derived. The correctness of the approximate solution is validated by comparison to an exact self-similar solution of the problem obtained for the particular case when the well's radius is assumed to be equal to zero. © Springer 2006.

http://dx.doi.org/10.1007/s11242-005-3326-5

Keywords

Approximate solution, Borehole, Fluid pressure, Geothermal reservoir, Hydraulic stimulation, Permeability